

## Abstracts of Technical Articles from Bell System Sources

*Receiver Band-Width and Background Noise.*<sup>1</sup> C. B. AIKEN and G. C. PORTER. In doubling the band-width of a radio receiver, it might be supposed that the apparent noise level would increase about 3 db since the noise energy brought in should be doubled. However, the high-frequency components of noise may be very much more troublesome from the standpoint of the listener than the low-frequency components. An experimental study shows that this is actually the case. Thus, if the noise level is low, as it should be whenever an effort is made to employ high fidelity reception, the dependence of the signal-to-noise ratio upon band-width is very apparent. While there are many variables involved, it seems safe to conclude that in doubling received band-width, the required increase in field strength may even be as much as 8 to 10 db.

*Cable Sheath Corrosion—Causes and Mitigation.*<sup>2</sup> J. B. BLOMBERG and NORVEL DOUGLAS. The causes and mitigation of telephone cable sheath corrosion are dealt with in this paper, which describes particularly a method of applying a counter potential to the cable sheath for the mitigation of corrosion from localized currents. This method, although not new, has had but limited application. It may find extensive future use for controlling corrosion on intercity toll cables, and in localities where street railways have been abandoned. In addition to a unique application of this method, there is also described the method of correcting by current drainage a particularly bad case of corrosion from stray current.

*The Detection of Frequency Modulated Waves.*<sup>3</sup> J. G. CHAFFEE. The comparative ease with which pure frequency modulation can be produced in electron oscillators at ultra-high frequencies has led to an examination of the problem of detecting a frequency modulated wave. In this region of frequencies the high ratio of frequency shift to modulating frequency gives rise to a very large number of side bands in the spectrum representing the modulated wave. Detection is usually accomplished by distorting the spectrum by means of a

<sup>1</sup> *Radio Engg.*, May, 1935.

<sup>2</sup> *Elec. Engg.*, April, 1935.

<sup>3</sup> *Proc. I. R. E.*, May, 1935.

selective network and then impressing the output voltages upon the grid of a detector. This process is treated analytically and formulas are given which permit the calculation of low-frequency detection products in terms of the transmission characteristic of the distorting network and the maximum frequency shift during modulation.

Measured detection products produced in such a system are compared with values calculated by means of the formulas which are given, and the results are shown to be in substantial agreement over the region in which certain simplifying assumptions are justified.

*Acceptance-Rejection Requirements in Specifications.*<sup>4</sup> H. F. DODGE. Specifications for quality of materials and finished products impose requirements for individual quality characteristics to distinguish between what may be considered satisfactory for a given purpose and what may not. For many characteristics, 100 per cent inspection or testing is not feasible; hence reliance must be placed on sampling a part of the whole. Under these conditions, 100 per cent conformance with requirements cannot be achieved with certainty and errors arising from sampling fluctuations cannot be avoided.

The sampling clauses included in specifications often provide criteria for the acceptance or rejection of lots of a product. These clauses constitute interpretations of the intent of the basic quality requirements and serve as a basis for action. With sampling, certain risks are assumed by both the consumer and the producer. One kind of risk is discussed, and the relationship between (1) the distribution of the risk between producer and consumer, and (2) the choice of acceptance criteria and sample size, is indicated for certain conditions.

*Selection and Development of Teachers for Communication Engineering Instruction.*<sup>5</sup> O. W. ESHBACH. One of a symposium of papers presented at the Conference on Electronics and Electrical Communication at the Ithaca meeting of the S. P. E. E. commenting on normal procedure in the selection and training of teachers, the trend of development in instruction in electronics and communication, attitudes characteristic of good teachers, responsibilities toward young instructors, and the means through which broadening of knowledge may be accomplished. Selection of the right individual, development of effective teaching technique, and the enhancement of knowledge and experience are emphasized as fundamental to successful teaching.

<sup>4</sup> *Proc. Amer. Soc. for Testing Materials*, Vol. 34, Part II, 1934.

<sup>5</sup> *Jour. Engg. Education*, April, 1935.

*The Correlation of Distillation Range with the Viscosity of Creosote*<sup>6</sup> (Part V of series, "Chemical Studies of Wood Preservation"). C. J. FROSCH. The results of viscosity measurements of a series of creosotes distilled from a single tar are given. It was found that these creosotes are truly viscous solutions, which permits the designation of the data as absolute viscosity. The viscosity-temperature data conform to two equations, one an empirical relationship previously found in an analogous series of crude oils, the other developed from theoretical considerations. It is remarkable that in spite of the complex nature of creosote, the viscosity data permit one to regard the material boiling below 355° C. as solvent and the residue above that temperature as solute. This is not true for any other temperature limit customarily used in creosote analysis.

*An Electron Diffraction Camera.*<sup>7</sup> L. H. GERMER. An experimental apparatus is here described for obtaining and photographing electron diffraction patterns from solid substances. It is designed for the study of the crystal structures of thin films and of superficial layers on massive blocks. Electrons from a hot tungsten filament are accelerated within an evacuated metal container by a potential difference of 50 or 60 kv. They are stopped down by appropriate slits to form a narrow beam which strikes the material under investigation. Electrons scattered by this material form a diffraction pattern characteristic of the crystal structure. This pattern is registered directly upon a photographic plate in the path of the scattered electrons.

*The Motion of a Bar Vibrating in Flexure, Including the Effects of Rotary and Lateral Inertia.*<sup>8</sup> W. P. MASON. In this paper a complete theoretical solution is given for a bar vibrating in flexure taking account of rotary and lateral inertia. The solution shows that the frequency of a bar free to vibrate on both ends, is asymptotic to the frequency given by the usual solution, neglecting rotary inertia, when the ratio of width to length is small, and approaches the frequency of a bar in longitudinal vibration when the width becomes comparable to the length. The theoretical frequencies have been compared with the published results of Harrison on the frequency of a quartz crystal vibrating in flexure, and have been found to agree within one per cent for a crystal whose width is less than half its length.

<sup>6</sup> *Physics*, May, 1935.

<sup>7</sup> *Rev. Sci. Instruments*, May, 1935.

<sup>8</sup> *Jour. Acous. Soc. Amer.*, April, 1935.

*Probability in Engineering.*<sup>9</sup> E. C. MOLINA. The purpose of this paper is to emphasize the practical value of probability theory in engineering. For this purpose a short introduction on probability theory as such is followed by a discussion of three problems from the domain of engineering with which the author is most familiar, namely, telephony.

The first problem deals with the switching, or trunking, of telephone calls. It illustrates the part played by probability theory in determining the amount of equipment an engineer must install in anticipation of *deviations* from normal or average service demands.

The bearing of probability theory on problems wherein one is confronted with the *cumulative* effect of a multitude of small independent discrepancies is indicated by the second problem presented in the paper. A long distance telephone circuit equipped with repeaters at several points is analyzed with reference to the cumulative effect of slight voltage variations in the battery supply at each repeater station.

The third and last problem is one on sampling. It introduces the engineer to the practical significance of *inverse* or *a posteriori* probability.

*Direct-Current Amplifier Circuits for Use with the Electrometer Tube.*<sup>10</sup> D. B. PENICK. A number of balanced, single-tube, direct-current amplifier circuits are compared, which are applicable to the four-element, low grid-current vacuum tube. The balance equations are stated for the most generally useful circuit, and magnitudes of the tube characteristics involved are given for the Western Electric No. D-96475 Tube. Experimentally determined values of circuit constants observed under balance conditions are also given. The stability of the circuit is discussed, and a convenient procedure for obtaining a balance by experimental methods is suggested.

*Internal Dissipation in Solids for Small Cyclic Strains.*<sup>11</sup> R. L. WEGEL and H. WALTHER. This paper presents the results of investigations of dissipation of energy in vibrating solids, mostly metals, by means of longitudinal and torsional vibrations of cylindrical rods. The amplitudes of strain used have been kept between  $10^{-5}$  cm./cm. and  $10^{-8}$  cm./cm., in which range the dissipation of energy is proportional to the square of the strain. The specific dissipative property of a material is expressed in three different ways: (1) Equivalent viscosity or the ratio

<sup>9</sup> *Elec. Engg.*, April, 1935.

<sup>10</sup> *Rev. Sci. Instruments*, April, 1935.

<sup>11</sup> *Physics*, April, 1935.

of stress to dissipative component of strain rate; (2) hysteretic constant defined as the area in ergs of the cyclic stress-strain diagram; and (3) elastic phase constant defined as the ratio of specific elastic reactance to equivalent viscosity. Within a range of frequencies 100 to 100,000 cycles per second the results show that the hysteretic constant is proportional to some power  $\Delta$  of the frequency, the numerical value of the exponent  $\Delta$  varying between the limits  $-\frac{1}{3}$  and  $+\frac{1}{2}$ , depending on the kind of material and its internal structural condition. Measurements made with longitudinal and torsional vibration indicate that dissipation is associated with dilatation as well as with pure shear. Preliminary studies are described showing the correlation between internal dissipation in metals and temperature hardness effects of annealing and aging.

*Broadcasting Studio Acoustics.*<sup>12</sup> S. K. WOLF and C. C. POTWIN. It is now of fundamental importance that studios be designed to provide an acoustic transmission characteristic that will insure the fullest benefits from the many recent improvements in transmitting and receiving systems. For this reason, the traditional "dead" studio, which was so common in the early days of radio, is no longer suited to the present technique of broadcasting.

This paper deals with improved methods of analysis and treatment, particular consideration being given to the problems of the small studio. A description of the high-speed level recorder, its operating characteristics and application to studio analysis, are included. The increased accuracy of instrumental measurement over computational methods in the solution of the problems of reverberation, multiple reflection and room resonance at various frequencies is explained. The factors governing the proper selection and distribution of acoustic materials are discussed and supported by actual measured data taken with the level recorder in studios designed in accordance with the methods advocated.

Two typical studio designs are illustrated, one suggesting sound reflective angular wall and ceiling surfaces adjacent to the performers, a moderate sound absorbent on the intermediate surfaces and a highly efficient absorbent on the surfaces adjacent to and surrounding the microphone. Distant pickup employed in this type of studio is briefly described.

*Quantitative Studies on the Singing Voice.*<sup>13</sup> S. K. WOLF, D. STANLEY and W. J. SETTE. The field of singing has been handicapped by the

<sup>12</sup> *Communication and Broadcast Engineering*, April, 1935.

<sup>13</sup> *Jour. Acous. Soc. Amer.*, April, 1935.

lack of suitable quantitative means for simply evaluating the various voice factors. With the aid of recently developed acoustic instruments, the authors have investigated physical characteristics of vocal tones, including attack, quality, vibrato, and power as a function of pitch. Measurements have been made and repeated on more than fifty singers in various stages of development. On the basis of the results, it is possible partially to evaluate and criticize a singer's technical equipment, and determine by periodic tests whether the voice is improving or deteriorating.

Better singers were found to attack a tone more vigorously and sustain it more uniformly, to possess a vibrato with a rate of about six per second, and to excel in those phases of artistry dependent upon proper control. They are also capable of producing relatively high amounts of acoustic power over wider singing ranges, the power increasing gradually with increasing pitch. Harmonic analyses, with the intensity levels of individual partial tones each averaged over an interval of about .5 second, have as yet failed to reveal consistent differences between good and bad voices.